REMARKS

Favorable reconsideration is respectfully requested in view of the following remarks.

Claims 1 and 7-9 were pending in this application when last examined and stand rejected.

On pages 3-6 of the Office Action, claims 1 and 7-9 were newly rejected under 35 U.S.C. § 103(a) as being unpatentable over either U.S. Pub. 2003/0202316, EP 1380569, or EP 1548866 in view of either JP 2002-063934 or Zhou et al.,"Low-melting, Low-viscous, Hydrophobic Ionic Liquids: N-Alkyl(alkyl ether)-N-methylpyrrolidinium Perfluroethyltrifluoroborate". Applicants respectfully traverse this rejection.

The invention of the claimed application relates to:

an ionic liquid comprising at least one member selected from the group consisting of N101.112[CF_3BF_3], N102.122[CF_3BF_3], N102.222[CF_3BF_3], N102.112[CF_3BF_3], Py102.1[CF_3BF_3], Pi102.1[CF_3BF_3], N1224[CF_3BF_3], N102.122[$C_2F_5BF_3$], N102.122[n-$C_3F_7BF_3$], N102.122[n-$C_4F_9BF_3$], N102.111[$C_2F_5BF_3$], N102.112[$C_2F_5BF_3$], N102.222[$C_2F_5BF_3$], N101.112[$C_2F_5BF_3$], Py101.1[$C_2F_5BF_3$], Py102.1[$C_2F_5BF_3$], Pi102.1[$C_2F_5BF_3$], N1224[$C_2F_5BF_3$], N102.112[n-$C_3F_7BF_3$], N102.222[n-$C_3F_7BF_3$], N102.111[n-$C_3F_7BF_3$], Py102.1[n-$C_3F_7BF_3$], Pi102.1[n-$C_3F_7BF_3$], N102.222[n- $C_4F_9BF_3$], N102.112[n-$C_4F_9BF_3$], Py102.1[n-$C_4F_9BF_3$], Pi102.1[n-$C_4F_9BF_3$], Py13[$C_2F_5BF_3$], Py14[$C_2F_5BF_3$], Py15[$C_2F_5BF_3$], Py16[$C_2F_5BF_3$], Py17[$C_2F_5BF_3$], Py1.10202[$C_2F_5BF_3$], Py1.202[$C_2F_5BF_3$], Mor14[CF_3BF_3], Mor14[$C_2F_5BF_3$], Mor14[n-$C_3F_7BF_3$], Mor14[n-$C_4F_9BF_3$], Mor1.102[CF_3BF_3], Mor1.102[$C_2F_5BF_3$], Mor1.102[n-$C_3F_7BF_3$], and Mor1.102[n- $C_4F_9BF_3$] <Claim 1>;

an electric double-layer capacitor and a lithium battery that comprise the ionic liquid according to claim 1 (claims 7 and 8); and

a method of producing the ionic liquid comprising mixing a compound containing at least one anion represented by $[BF_3(C_nF_{2n+1})]^-$(n=1-4) with a compound containing as a cationic component at least one organic ammonium ion selected from the group consisting of N101.112, N102.122, N102.222, N102.112, Py102.1, Pi102.1, N1224, N102.111, Py101.1, Py13, Py14, Py15, Py16, Py17, Py1.10202, Py1.202, Mor14, and Mor1.102 (claim 9).

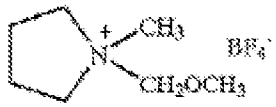
The inventors of the present application found that a combination of the above-described specific cations with $[BF_3(C_nF_{2n+1})]^-$ results in a remarkably useful solvent for electrochemical devices and organic reactions, compared to a combination of cations with $[BF_4]^-$. Specifically, a

combination of the above-described specific cations with $[BF_3(C_nF_{2n+1})]^-$ exhibits a very low melting point or glass-like properties, a very low viscosity, and/or a very high electrical conductivity. The invention of the present application is accomplished based on these new findings.

Explanation of Cited Documents

Kawasato (US 2003/0202316 A1)

Kawasato discloses

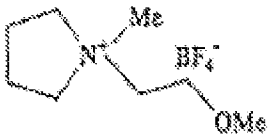


Py101.1[BF_4] in paragraph [0032].

However, Kawasato is completely silent about $[C_2F_5BF_3]^-$.

Sato (EP 1380569 A1)

Sato discloses



Py102.1[BF_4] as formula (5) in paragraphs [0038] and [0175].

Further, Sato states in paragraph [0176] that Py102.1[BF_4] "was a liquid at room temperature (25°C)".

However, Sato is completely silent about $[C_2F_5BF_3]^-$.

Maruo (EP 1548866 A1)

Maruo discloses

Py102.1[BF_4] as formula (5) in paragraph [0023].

However, Maruo is completely silent about $[C_2F_5BF_3]^-$. Applicants further note that the publication date (June 29, 2005) of Maruo (EP 1548866 A1) is later than the filing date

(December 24, 2004) of the present application. Thus, this reference cannot be properly applied as prior art.

Takeda (JP 2002-63934)

Takeda was cited in the previous Office Action. This is an unexamined patent publication that discloses an electrolyte represented by Formula (2) in which a boron compound is dissolved in a nonaqueous solvent:

$X^+[(Rf)_nBF_{4-n}]^-$ ... (2)

wherein X^+ represents an alkali metal ion or onium ion, Rf represents a perfluoroalkyl group, and n represents an integer of 1 to 4. Please see Claim 1.

Takeda also discloses an electric double-layer capacitor that uses $TEMA^+CF_3BF_3^-$ in Table 1.

However, Takeda merely discloses triethylmethylammonium as the cation X^+ in paragraph [0006] and Table 1 (electrolyte liquid No. 2), and is completely silent about a pyrrolidinium ion.

Zhou ("Low-melting, Low-viscous, Hydrophobic Ionic Liquids: N-Alkyl(alkyl ether)-N-methylpyrrolidinium Perfluroethyltrifluoroborate" Chemistry Letters, Vol. 33, No. 12 (2004), 1636-1637)

Zhou is a document published within a year before the filing date of the present application (December 24, 2004). Further, Zhou is a document written by the inventors of the present application. Attached herewith is a Declaration establishing such and removing Zhou as prior art.

Non-Obviousness of the Invention of the Present Application

As described above, the inventors of the present application found that a combination of specific cations such as Py101.1 and the like with $[C_2F_5BF_3]$ results in a remarkably useful solvent for electrochemical devices and organic reactions, compared to a combination of these cationic components with $[BF_4]^-$.

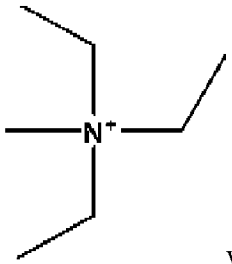
Specifically, as described, in the present specification (Table 4, line 9), Py101.1$[C_2F_5BF_3]$ exhibits a very low viscosity (i.e., 37/m Pas). On the other hand, when

Py101.1 is combined with $[BF_4]^-$, the viscosity is remarkably reduced (100/m Pas). Attached herewith is a document (Chem. Eur. J. 2006, 12, 2196-2212), in Appendix 1, that describes the viscosity of Py101.1$[BF_4]$. Please see page 2199, Table 1 (Entry 35).

In contrast, Kawasato, Sato, Maruo, and Takeda nowhere describe any specific combinations such as Py101.1$[C_2F_5BF_3]$ or the like.

Specifically, Kawasato, Sato, and Maruo merely describe Py101.1$[BF_4]$ and Py102.1$[BF_4]$, and nowhere even suggest combining Py101.1 with $[C_2F_5BF_3]^-$.

Further, Takeda merely describes combining triethylmethylammonium ($TEMA^+$)



whose structure is completely different from that of Py101.1 with $CF_3BF_3^-$.

Applicants note that physicochemical properties of an ion pair such as the melting point and viscosity are very difficult to predict from the structure thereof. Accordingly, even a person skilled in the art could not predict the effects of the claimed invention of the present application based on the cited references. The properties of a given ion pair are unpredictable and therefore not obvious.

Further, the Examiner states that "[a] person having ordinary skill in the art would be motivated to substituting the trifluoroborate $[BF_3]^-$ anion with either the $[(R_f)_nBF_{4-n}]$ cation or $[R_fBF_3]$ cation in order to reduce the moisture content of the nonaqueous electrolyte that causes metal part of an electrochemical element corrode or make the nonaqueous electrolyte disassemble as suggested by Takeda . . .".

Takeda shows in Table 1 that the electric double-layer capacitor that uses $TEMA^+CF_3BF_3^-$ is slightly superior to the electric double-layer capacitor that uses $TEMA^+BF_4^-$ in terms of the effect of preventing a reduction in capacitance. However, Takeda's Table 1 also shows that the conductivity (7.1 mS/cm) of the electric double-layer capacitor that uses $TEMA^+CF_3BF_3^-$ is lower than that of the electric double-layer capacitor that uses $TEMA^+BF_4^-$ (8.5 mS/cm).

Important factors for the electric double-layer capacitor include not only conductivity level but also ion size, because the entrance and exit of the ions into and out of pores of the activated carbons used as electrodes is important. Accordingly, BF_4^- is more favorable than $CF_3BF_3^-$ in terms of ion size.

Accordingly, Applicants contend that a skilled person in light of the disclosure of Takeda would prefer using BF_4^- rather than $CF_3BF_3^-$ as an anion.

Thus, Takeda discloses a statement that would prevent a person skilled in the art from combining cations such as Py101.1 and the like with $[BF_3(C_nF_{2n+1})]^-$, and thereby teaches away from the present invention.

Therefore, even a person skilled in the art would not easily arrive at the invention of the present application.

Thus, Applicants contend that (1) the physicochemical properties of a given ion pair are unpredictable and therefore a person of ordinary skill in the art would not be taught or suggested the claimed ion pair and (2) a person of skill in the art would be taught away from the claimed ion pair because $TEMA^+CF_3BF_3^-$ has lower conductivity and is less advantageous in ion size. Furthermore, as noted, Zhou et al. cannot be applied as it is not by another and EP 1548866 cannot be applied as it was published after the filing date of the present application.

Thus, for the above-noted reasons, this rejection is untenable and should be withdrawn.

CONCLUSION

In view of the foregoing remarks, it is respectfully submitted that the present application is in condition for allowance and early notice to that effect is hereby requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact the undersigned attorney at the telephone number below.

Respectfully submitted,

Hajime MATSUMOTO et al.

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December 27, 2010